PE - 8

USING INTEGRATED ANALOGY IN PHYSICS EDUCATION TO BUILDING CONCEPT OF REPRESENTATION : THE WAY TO BE A GREAT INVENTOR

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Abstract

Analogy can be powerfull teaching tool to teach physics especially to understand concept in physics education which need deep understanding in learning. This paper has reviewed some research and literature of analogy in physics education. The first part of the paper will present theoretical framework of analogy and integrated curriculum, such as model of analogy, model of integrated curriculum and some results of research in teaching analogy in science. The second part of this paper will explore analogy in physics education and how to join analogy and integrated curriculum to be integrated analogy. Finally this paper to make pattern of integrated analogy in physics education to been adapted in Indonesian curriculum.

Key words: analogy, integrated curriculum, physics education

INTRODUCTION

Meaning of analogy

Analogy is everwhere in physics. it is used by working physicists, physics teachers, and students learning physics. the term of analogy refers to comparisons of structures between two domains; a domain familiar or known to the learner and a new domain by Duit (1991). further suggest that an analogy is a relation between parts of the structures of two conceptual domains and may be viewed as a comparison statement on the grounds that these structures bear some resemblance to one another" Treagust et al. (1992). in physics education teaching defenition of analogy is a process of identifying similarities between two concepts. One concept is familiar called “analog” and the other one is unfamiliar called “target”. Analogy depicts concepts hard to understand in physics to be easy concepts which can understand simply. As can be seen in figure 1, figure 2, the analog and the target of physics concepts.

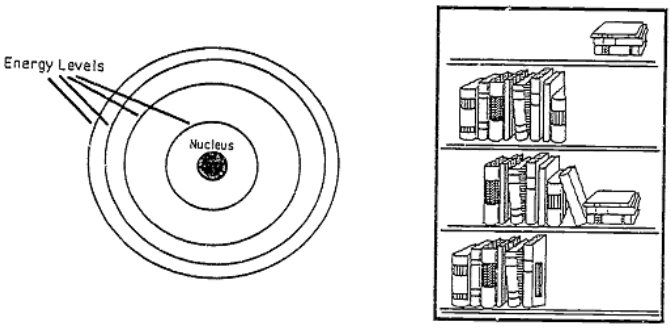

Figure 1. In Bohr's model of the atom, electrons are located in energy levels like shelves in a bookcase.

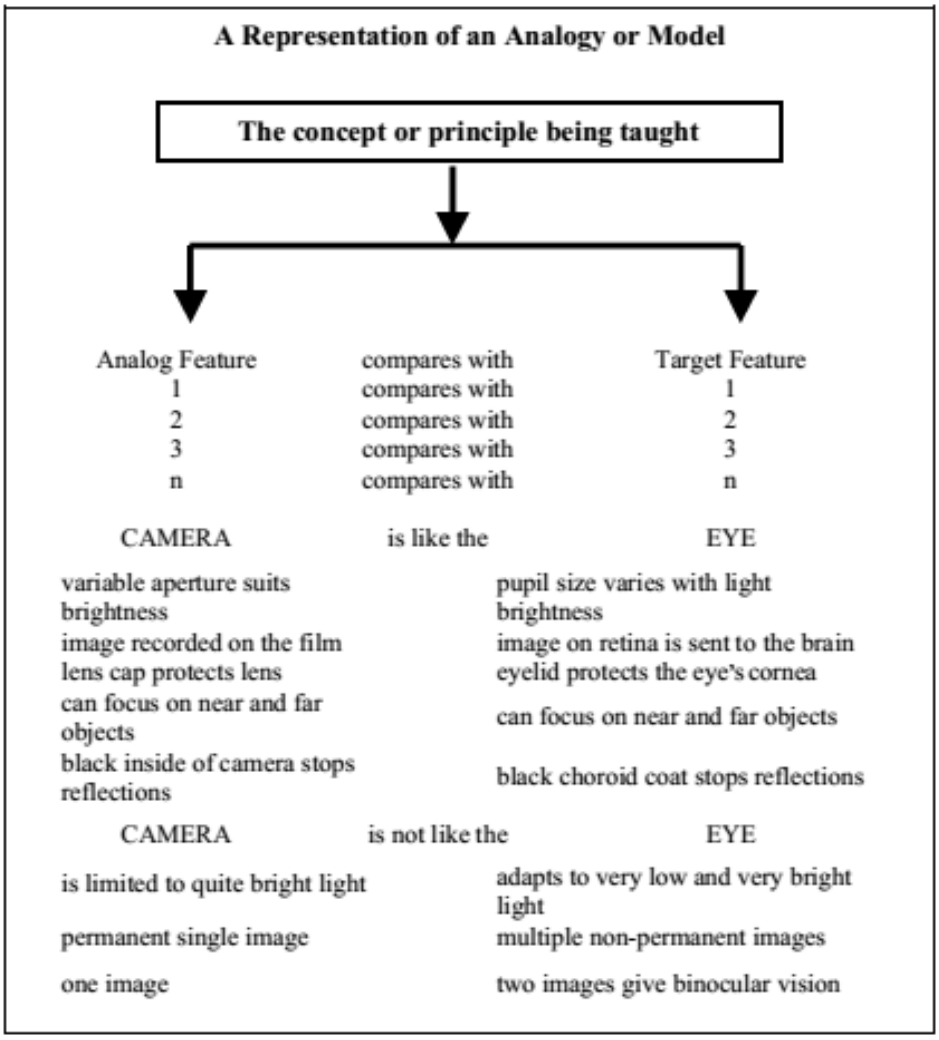

Figure 2. camera like an eye analogy

Figure 1 and figure 2 are models of analogy. One is trying to explain part and function of eye and the another one is trying to explain concept of atom bohr.

Another research which had been done by Podolefsky and Finkelstein showed the data on teaching using analogy, teaching with analogy can be used to teach about EM waves. This research result show that this teaching method was effective at generating different inferences about EM waves among students taught with different analogies.

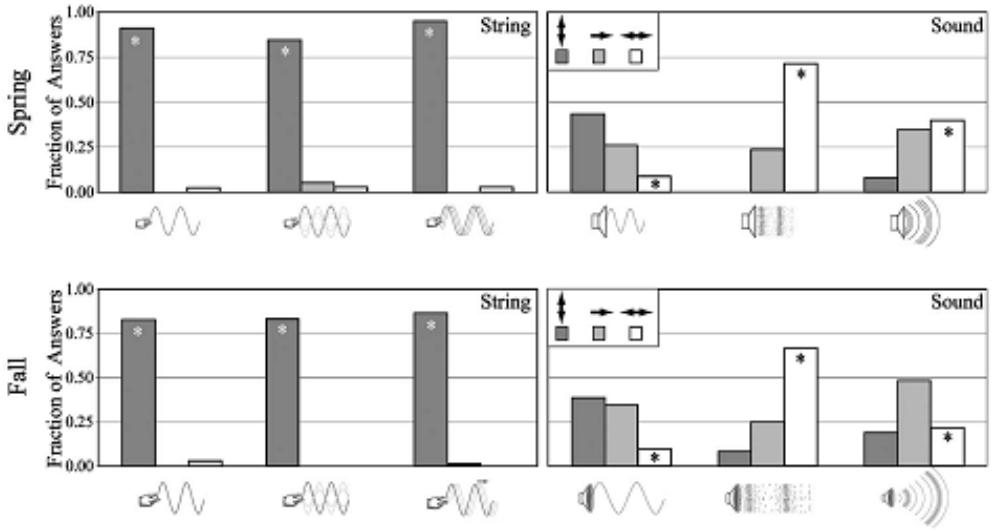

Figure 3. Student responses wave motion question

In Figure 3. Student responses to the motion question on the representation assessment. String group (left) and sound groupright. Initial study results spring are shown in the top two graphs; follow-up study results (fall) are shown in the bottom graphs. The choice of iconographic representation is shown below the horizontal axis. The three top answers (up/down, to the right, side-to-side) are represented by the directional arrows in the legend. We look for patterns of association between representation and answer. There was no association for string ($x^2: p > 0{,}3$) but significant association for sound ($x^2: p > 0{,}01$) The "*" indicates the correct answer.

Analogy has been used learning and teaching science especially in physics education, but no one of researchs connects all of analogies to be one completed analogy learning. Using integrated curricula to teach analogy will connect all of analogy to be one completed analogy and make pattern of thinking how to make analogy well.

How to teach analogy

Throughout this paper, the framework to teaching analogy is shown in figure 3. This framework is based some researchs about how to teach analogy. The focus of framework analogy guide has three stages for the systematic presentation of analogies and resembles the planning phases of expert teaching and the action research model. The framework guide is illustrated in Figure 3.

Integrated Analogy

Integrated analogy is combination of analogy and integrated curriculum. Integrated curriculum according model of forgaty have ten different models. There are is fragmented, nested, shared, threaded, immersed, connected, sequenced, webbed, integrated, and netwotked.

The Focus of Analogy – Plan Lesson

Pre- Lesson FOCUS	
CONCEPT	Is the concept difficult, unfamiliar or abstract
STUDENT	What ideas do the student already have about the concept?
EXPERIENCE	What familiar experiences do student have that I can use?

in- Lesson FOCUS	
	Check student familiarty with the analog
LIKES (mapping)	discuss ways in which the analog is like the target are the idea surface feature or deep relation?
UNLIKES (mapping)	Discuss ways in which the analog is unlike target

Post- Lesson FOCUS	
CONCLUSIONS	was the analog clear and useful, or confusing
IMPROVEMENT	What changes are needed for the following lesson? What changes are needed next time I use this analogy

Figure 3. framework to teaching analogy

DISCUSSION

We have shown that analogies are generative for physics learning and instruction, and further demonstrated that analogies can be generative when taught. In this paper, We will discuss two important points of learning and teaching analogy in science especially physics. The first point is why not all of concept in physics taught with analogy and what is the useful analogy, and the second point we will discuss how to make a solution to teaching all concept in analogy together and make a pattern to learn with analogy.

Analogy cannot be used in all concept of physics material effectively because of not all concept which had been tranformed to analogy is useful. Accordng review some research, there are three suggestions which make analogy useful. The first is when analogy should be used. Analogy can be useful when target concepts are difficult or challenging, when target concepts can not be visualized or abstract concept, when target concepts are introduced in the first meeting. On the other hand, analogy can be not useful when target concepts are simple or already understood, when target concepts are overwhelming, when target concepts must be memorized. The second is what types of analogies are useful. In general, good analogy is simple, easy to remember and having familiar analog concepts. The third is how analogies should be presented in class. Analogies can be presented with making the purpose for using the analogy clear, giving explanation the relationships between the analog and target concepts, using visuals, and using easy-to-understand words and enthusiasm to present analogies. With

using three aspects to make useful analogy, analogy will be tought effectively in learning and instruction

To teach all analogy in every concept together, we can join all useful analogy from every concept in science especially physics. Figure 3 will show a pattern of integrated analogy using threaded model in physics education. This integrated analogy use threaded model from integrated curricula.

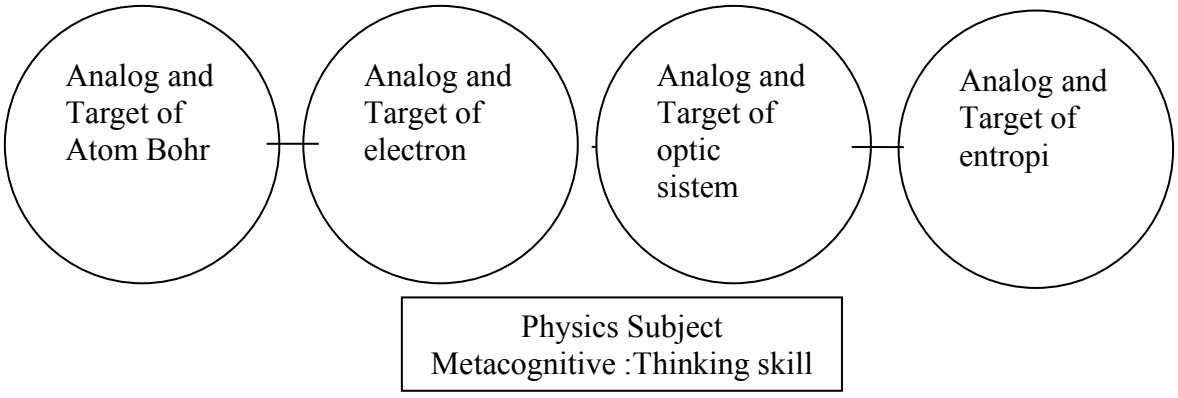

Figure 3.integrated analogy with threaded model

Using integrated analogy in learning make a pattern of thinking skill of student. Analogy help student to think like an inventor with learning concept with analog and comparing it with analog. To be a great scientist student has to understand analogy well and reverse it to make something new like new theory or new invention.

CONCLUSION AND SUGGESTION

This paper has briefly reviewed some literatures on analogy in physics learning and instruction. Early studies in this area showed that analogies were more than convenient terminology, but actually generated inferences between base and target domains. When applied to physics, this means that the analogies students generate will affect their understanding of physics concepts. On the other hand, not all of analogy is useful. three suggestions which make an analogy useful are about when analogy should be used, what kinds of analogies are good or useful, and how analogies should be presented in class to be useful.

In the last part, reviewer attempt to give a solution which makes analogies to be useful with combine them togerther using integrated curiculla to be implemented in Indonesian curriculum. Analogies which are joined together is called integrated analogy. Integrated analogy help student make a pattern to learn analogy easly and efectivelly with joining their in model of integrated curricula. Reviewer suggest that with combining analogy an integrated curicula will make analogy to be useful for every concept and students to understand how to make analogy by themselves.

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